US005421536A

United States Patent [19]

Hertel et al.

[11] **Patent Number: 5,421,536**

[45] **Date of Patent: Jun. 6, 1995**

[54] **SURFACE WINDER WITH RECYCLED MANDRELS AND METHOD**

[75] Inventors: **James E. Hertel**, Green Bay; **Gerald W. Buxton**, Shawano; **Lawrence J. Oliver**, Green Bay, all of Wis.

[73] Assignee: **Paper Coverting Machine Company**, Green Bay, Wis.

[21] Appl. No.: **93,342**

[22] Filed: **Jul. 19, 1993**

[51] **Int. Cl.**[6] **B65H 35/04**; B65H 19/30

[52] **U.S. Cl.** **242/526.1**; 242/533.4; 242/533.6; 242/542.3

[58] **Field of Search** ..... 242/56.8, 65, 66, 67.1 R, 242/68.4, 78.1, 78.6, 526.1, 533.4, 533.6, 542.3

[56] **References Cited**

U.S. PATENT DOCUMENTS

Re. 28,353	4/1965	Nystrand et al. .	
2,870,840	1/1959	Kwitek .	
3,071,259	1/1963	Nystrand et al. .	
3,131,880	5/1964	Miller et al.	242/66
3,148,843	9/1964	Turner et al. .	
3,718,302	2/1973	Mount et al.	242/56.9 X
3,823,887	7/1974	Gerstein	242/56.8 X
4,783,015	11/1988	Shimizu	242/66 X
4,828,195	5/1989	Hertel et al. .	
4,856,725	8/1989	Bradley	242/66
5,104,055	4/1992	Buxton	242/66
5,137,225	8/1992	Biagiotti	242/66

Primary Examiner—John P. Darling
Attorney, Agent, or Firm—Tilton, Fallon, Lungmus & Chestnut

[57] **ABSTRACT**

A surface winder and method employing recycled mandrels wherein a frame provides a winding path, a first winding drum for continuously advancing a web in the path and positioned on one side of the path, a mandrel inserter for introducing mandrels sequentially into the path for contact with the web, a second winding drum on the frame on the other side the path for coacting with the first winding drum in developing a log and a stripper on the frame for stripping each mandrel sequentially out of its associated log.

12 Claims, 3 Drawing Sheets

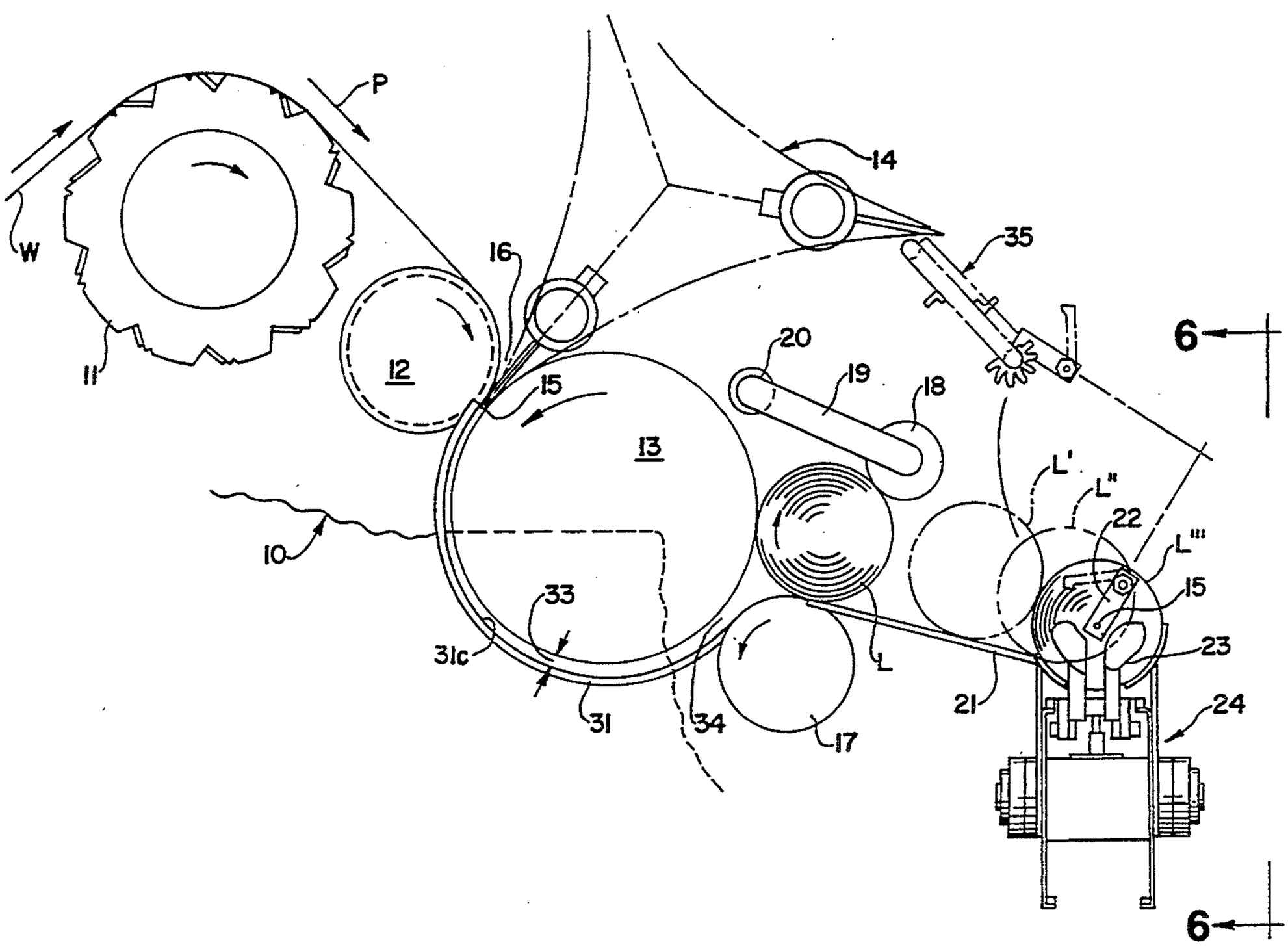


Fig. 1

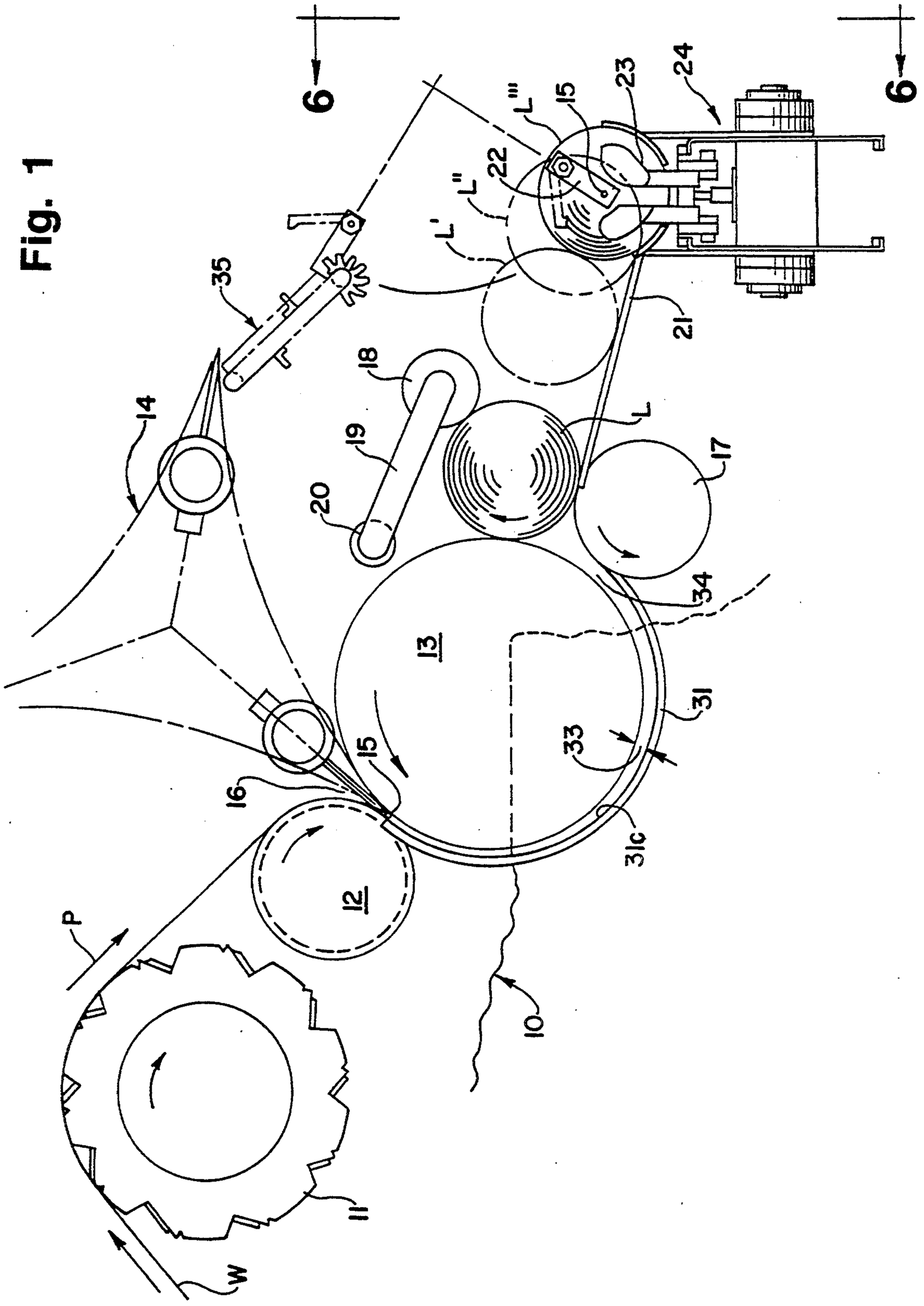


Fig. 2

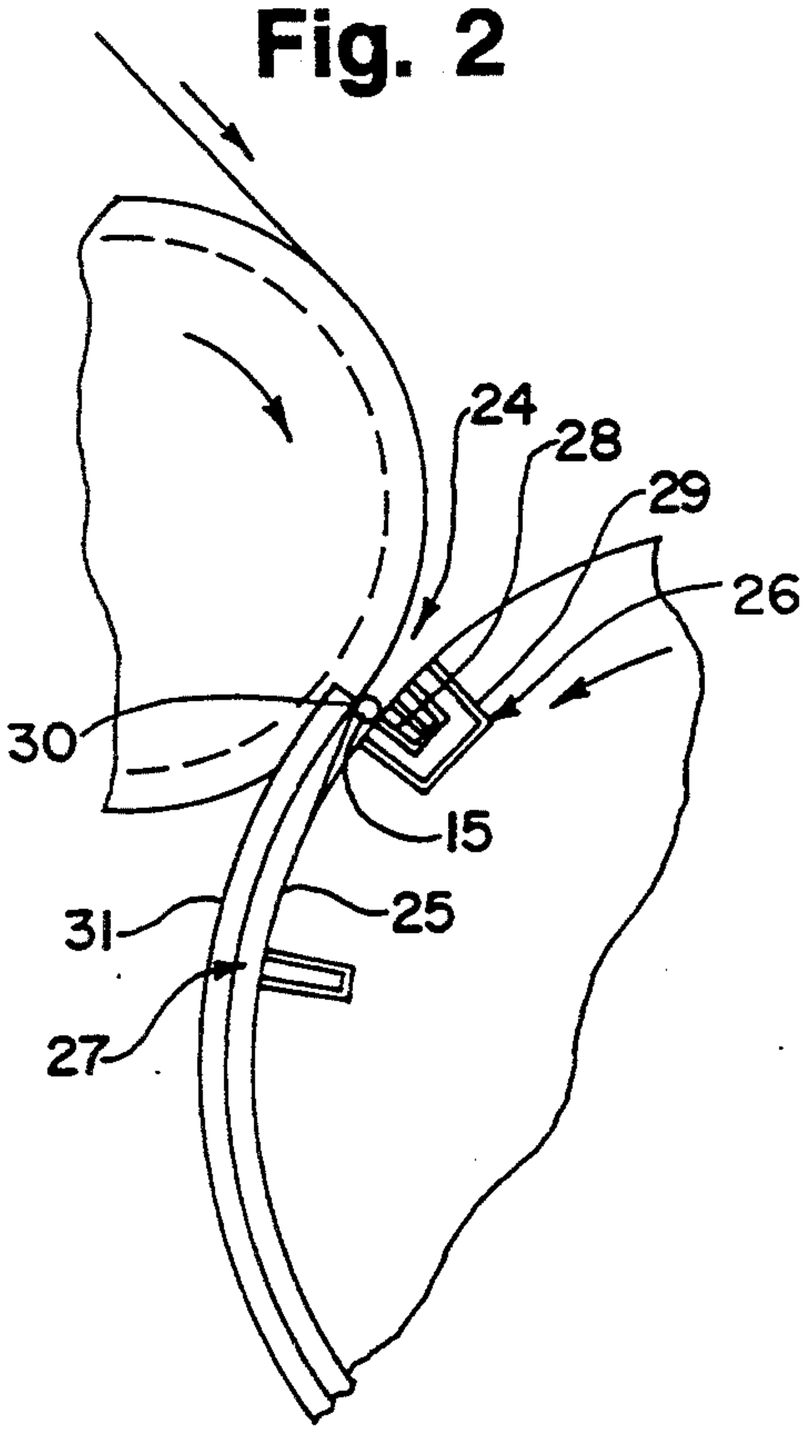


Fig. 3

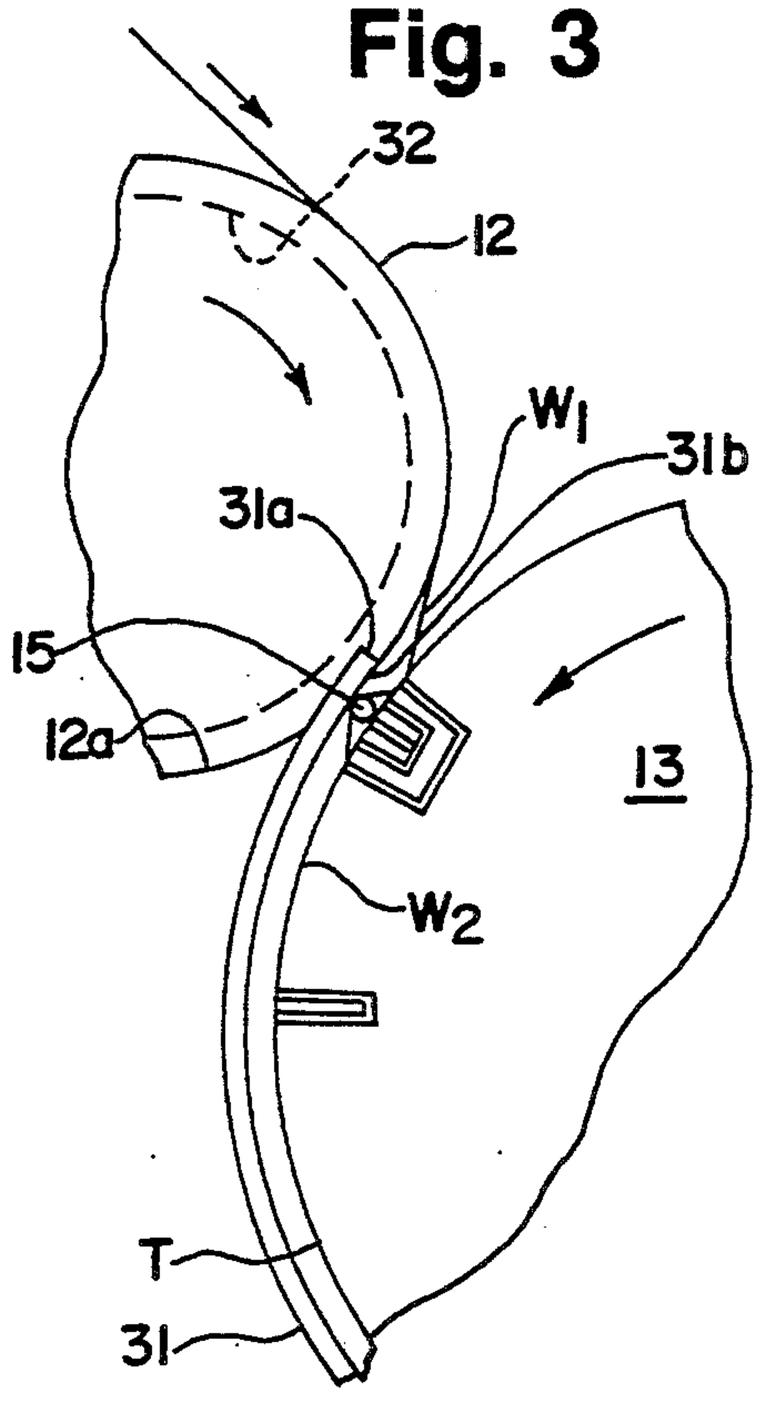


Fig. 4

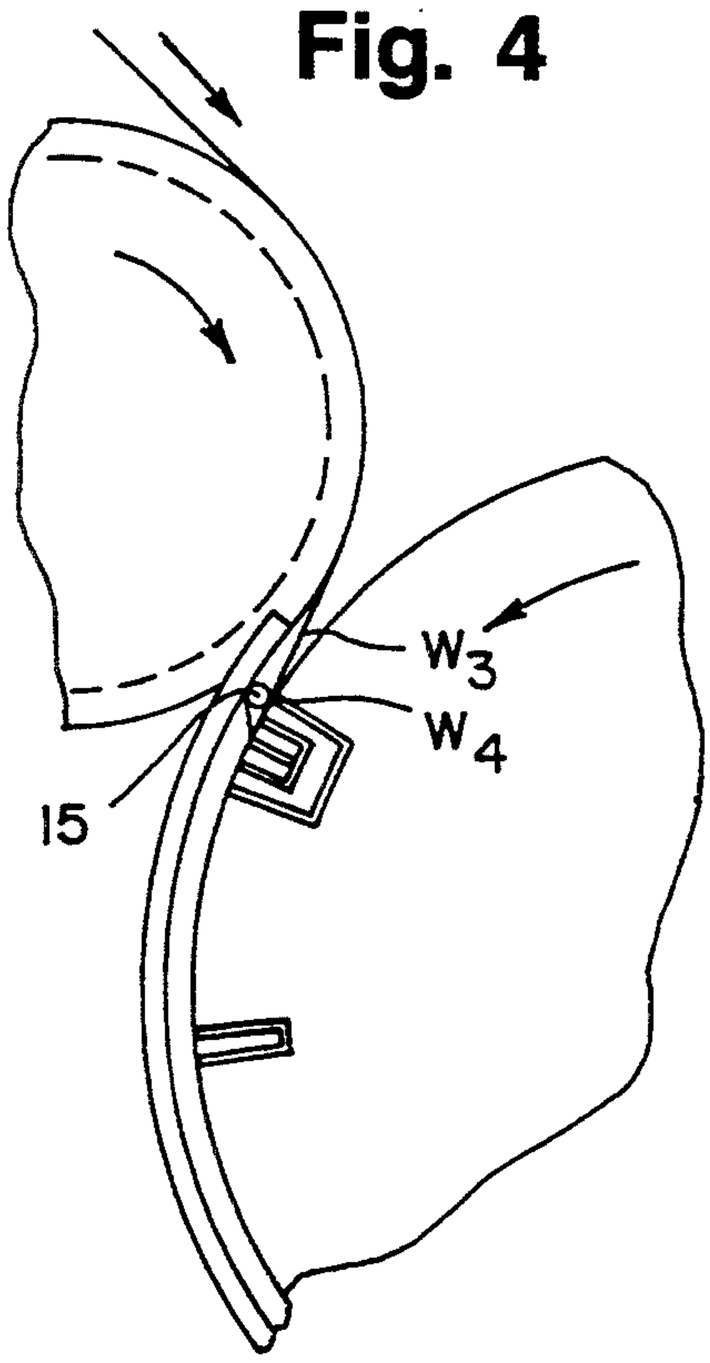
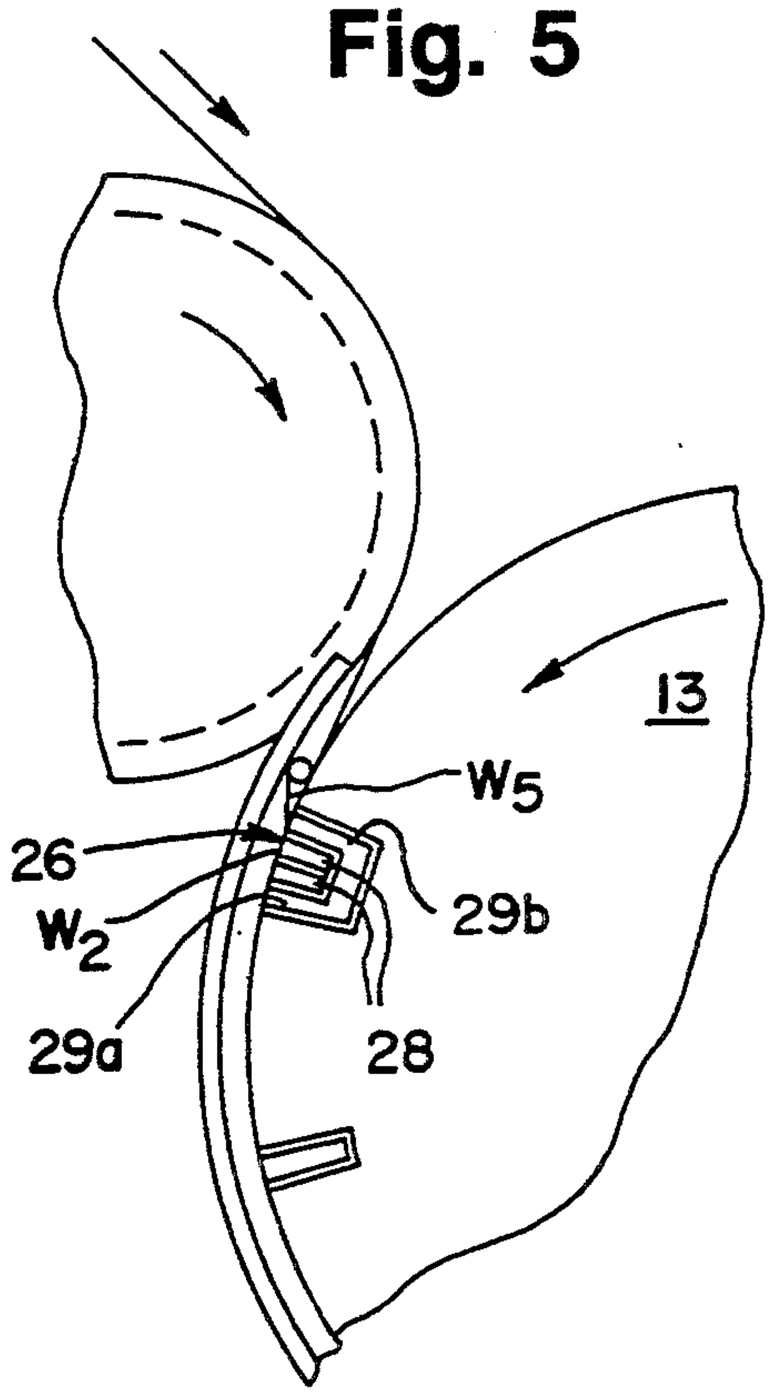


Fig. 5



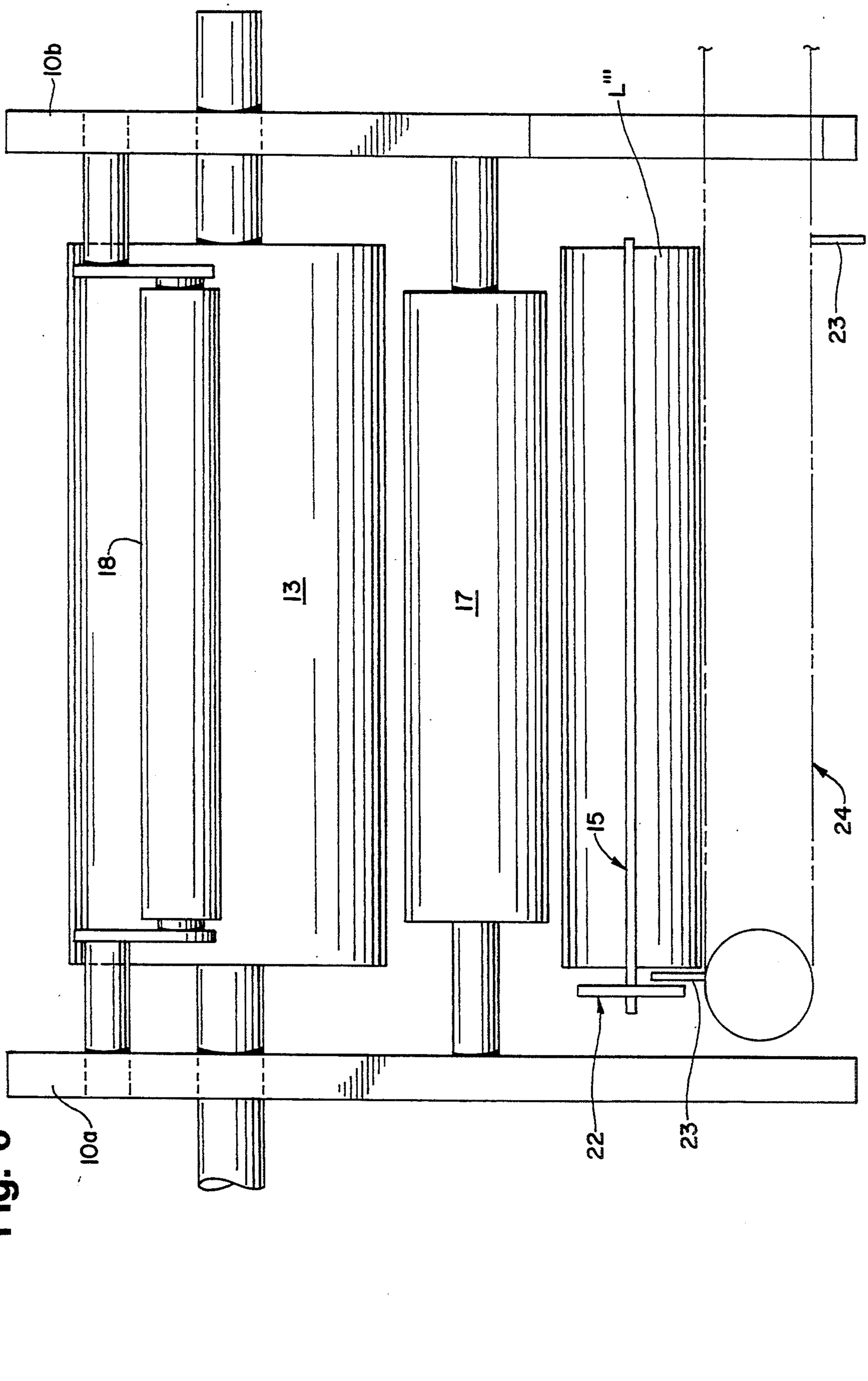


Fig. 6

SURFACE WINDER WITH RECYCLED MANDRELS AND METHOD

BACKGROUND AND SUMMARY OF INVENTION

This invention relates to a surface winder with recycled mandrels and method and,, more particularly, to a surface winder wherein the web is enveloped directly around the mandrel so as to develop, in effect, a "coreless" log of convolutely wound material.

The invention is to provide a winder which employs "free" mandrels which are pulled out of the finished log and thereafter recycled into the winding process. Recirculated mandrels have been used for a long time—see U.S. Pat. No. 3,148,843.

The main objective of the invention is to produce a wound product without separate core material. It is also desirable to have a hole in the center of the product so that a variety of dispensers can be used. The hole is preferably small, in the range of 0.375 inches (about 10 mm) to 0.750 inches (about 20 mm), so that the rolls cut from the log are stable. By stable, we mean that the wound structure will not collapse or unravel internally during cutting, packaging, shipping, etc. Larger holes tend to require a "fixing agent" to stabilize the area near the "core".

Another objective is to wind these products in a high speed, continuous manner. Currently the products are wound onto free mandrels but in a start/stop operation. These winders are typically limited in production due to the need to decelerate the entire line (unwind, embosser, rewind) to zero web speed during the transfer process.

Typical center winder technology also does not respond to this need because the small diameter mandrels would not have adequate stiffness to rotate at high speeds. For a 100 inch (2.5 meters) wide winder running at 2,500 FPM (800 mpm) the minimum mandrel diameter is about 1.5 inches (38 mm). Hence, the combination of production requirements and small hole size negate the center winding option.

BRIEF DESCRIPTION OF DRAWING

The invention is described in conjunction with an illustrative embodiment in the accompanying drawing, in which

FIG. **1** is a fragmentary side elevational view, partially schematic, of the operational elements of the invention;

FIG. **2** is a fragmentary schematic elevational view of the elements in the central portion of FIG. **1** in the positions they assume at the beginning of a winding cycle;

FIG. **3** is a view similar to FIG. **2** but slightly later in the winding cycle showing the leading edge portion of a severed web about to envelop an inserted mandrel;

FIG. **4** is a view similar to FIGS. **2** and **3** but again somewhat later in the winding cycle;

FIG. **5** is a view similar to FIG. **4** but even later in the winding cycle; and

FIG. **6** is an end elevational view such as would be seen along the site line **6—6** applied to FIG. **1**.

DETAILED DESCRIPTION

Referring first to FIG. **1**, the numeral 10 designates generally a frame for the machine which is seen in FIG. **6** to include side frames **10***a* and **10***b*. As is conventional

in the winder art, the side frames **10***a* and **10***b* rotatably support a plurality of rolls or drums for processing of a web and define essentially a winding path for the web in its travel from a parent roll (not shown) toward becoming a retail sized log of paper, other web material, foil, etc. For additional details of winders, reference may be made to co-owned patents RE 28,353 and U.S. Pat. No. 4,828,195.

Starting with the upper left hand portion of FIG. **1**, the symbol W designates a web of material which is being advanced through a path designated in part by the symbol P and which first includes travel around a perforator roll **11** which operates against an anvil (not shown) to transversely perforate the web along equally longitudinal spaced lines of transverse perforation. Conventionally the spacing between lines of perforation in toilet tissues may range in different parts of the world from 4 to 5 inches (100–125 mm). Different spacing are employed for kitchen toweling. A suitable perforator is seen in co-owned U.S. Pat. No. 2,870,840.

The web W in continuing along the path P next encounters a lay-on roll designated **12** which again is suitably rotatably mounted like the other rolls or drums within the frames **10***a* and **10***b*. Positioned adjacent the lay-on roll **12** and still further in the path of travel of the web P is a first winding drum or bedroll generally designated **13**.

Still referring to FIG. **1** and now above and slightly to the right of the bedroll **13** is a mandrel-introducing mechanism generally designated **14**. In the illustration given, this is a hypocycloidal introducing mechanism of the nature shown in co-owned U.S. Pat. No. 4,856,725 which provides a gripping action on a cylindrical member.

The mechanism **14** functions to introduce a mandrel such as designated **15** into the nip **16** between the lay-on roll **12** and the bedroll **13**. Thus, the mandrel **15** follows a portion of the winding path P inasmuch as the mandrel and the web are now proceeding together at least partway around the periphery of the first winding drum **13**.

Before going into further details relationship of the mandrel **15** and first winding drum **13**, we describe the remainder of the winding path P. After the mandrel proceeds around a portion of the periphery of the bedroll **13**, it encounters the second winding drum or lower **17** which cooperates with the first winding drum or bedroll **13** in developing a full diameter log L of convolutely wound material. In conventional fashion, the log is maintained in what could be considered a three roll cradle by means of a pivotally mounted rider roll **18** which is mounted on arms **19**. The arms **19** are fixed to a cross shaft **20** which is suitably journaled within the side frames **10***a*, **10***b*.

After the log L has been developed and a new mandrel is in the process of being wound, the log L rolls down a table **21** as indicated by the positions L′, L″ and finally L‴.

At this juncture, a stripping operation is performed wherein first the mandrel **15** which has an end protruding beyond the log L‴ (FIG. **6**) is gripped by means of a jaw gripper **22**. Between the adjacent end of the log L‴ and the gripper **22**, a pusher **23** is interposed. The pushers **23** are carried by a conveyor mechanism generally designated **24** and operates to strip the log L‴ from the mandrel **15** by moving the same axially along the

mandrel **15** and onto an extended portion of the conveyor **24** (see FIG. **6**).

OPERATION

FIG. **1** shows the inventive winder using a very small diameter mandrel **15**. The main objective of this winder is to produce a coreless roll with a very small hole in the center. For this purpose, the rotation of the bedroll **13**, the operation of the core inserter **14** and the speed of advance of the web W are coordinated so that the bedroll **13**, the mandrel **15** and the perforation register **25** are generally in the relation shown in FIG. **2**. The bedroll **13** uses vacuum port means generally designated **26** and **27** to hold the web against the bedroll surface. The vacuum port **26** is seen to include two separate arrangements of axially extending ports in the outer surface of the bedroll **13**. The port means **26** include a triple row of primary vacuum ports **28** and a secondary double row of vacuum ports **29**. The ports **29** are arranged to circumferentially flank the primary vacuum ports **28**. The double row of vacuum ports **27** is spaced forwardly in the direction of rotation from the first mentioned vacuum port means **26**. The main port means **26** is channeled to two separate vacuum supplies (not shown) so that the outer rows of vacuum ports **29** can be vented independently from the inner row **28**.

As can be seen in FIGS. **2–4**, the inventive transfer uses an arcuate stationery plate to produce a pinch cutoff. This is analogous to the structure described in co-owned U.S. Pat. No. 4,828,195 except that the targeted perforation is isolated in part by means of vacuum ports **27**. These ports **27** hold the tail T (FIG. **3**) of the just-finished log on the bedroll **13** so that severing takes place between the ports **27** and the pinch point **30** developed by the coaction of the mandrel **15** and the arcuate stationary plate **31**.

It will be noted in FIG. **3**, for example, that the lay-on roll **12** is equipped with an annular groove **32** in its outer surface which accommodates the inlet end **31***a* of the stationary plate **31**. Thus, the inlet end **31***a* has a surface **31***b* facing the bedroll drum **13** which is essentially tangent with the outer surface **12***a* of the lay-on drum **12**. This facilitates the introduction of the mandrel **15** by the inserter mechanism **14** because the mandrel **15** is then approaching a nip defined by adjacent rolls **12, 13** and, in part, by the stationary plate **31**.

As seen in FIG. **3**, the pinching of the web causes a small amount of slack as at W_1 to be formed between the lay-on roll **12** and the mandrel **15**. This slack web is immediately attracted to the bedroll **13** by the vacuum port means **26** and also directed to the bedroll **13** and away from the lay-on roll **12** by the centrifugal force of the web on the lay-on roll **12**. The vacuum port means **26** then pull the slack web W_1 under the rolling mandrel **15**.

Just described is what happens to the web in the portion W_1 on the upstream side of the mandrel **15**. Now turning to what happens to the portion of the web on the downstream side of the mandrel **15** which is designated W_2. This is the leading edge portion of the web which becomes the beginning of the next log of convolutely wound material. Although the web leading edge portion W_2 is being drawn toward the surface of the bedroll **13** by virtue of the vacuum port means **26**, it is maintained in a relatively stationary relationship to the surface of the bedroll by virtue of the pinching occurring at the point **30** (FIG. **2**). Thus the bedroll **13** continues to advance and slides underneath leading edge portion W_2 which remains substantially stationary during this time because it is still pinched against the stationary plate at the pinch point **30**.

FIG. **4** illustrates what happens in the enveloping of the mandrel **15** by the web a short time later than that depicted in FIG. **3**. There is a further leading edge portion of the web designated W_3 which is rearward in the direction of advance, i.e., upstream from the previously mentioned leading edge portion W_2. This leading edge portion W_3 is now in the process of being folded under the mandrel **15** as at W_4. Now referring to FIG. **5**, the folded nature of the leading edge portion is seen more clearly and is designated W_5. This folded edge W_5 is lifted and rolled by the rubbing action of the web leading edge portion W_2 moving over it. The vacuum port means **26** is arranged to enhance this tendency by allowing the web leading edge portion to expose the first row of ports **29***a*, hence allowing the vacuum therein as well as that in port **29***b* to decay prior to the vacuum in the ports **28**. This, in turn, allows the web leading edge portion W_3 to be attracted to the bedroll **13** while the folded leading edge portion W_5 is being released. Once the folded leading edge portion W_5 is raised off of the bedroll **13**, it is trapped inside of the web leading edge portion W_2 by virtue of the rolling of the mandrel **15**.

The geometry of the arcuate stationary plate **31** is arranged to allow for the rapid buildup diameter during the first part of the winding cycle. The gap **33** between the periphery of the bedroll **13** and the interior **31***c* of the stationery plate **31** (see particularly FIG. **1**) gradually increases in proceeding from the upper inlet end where the mandrel **15** is being inserted until the outlet end **34** is reached. When the new log reaches the outlet end **34**, it rolls off of the plate **31** and proceeds to wind between the first or upper winding drum **13** and the second or lower winding drum **17**. As indicated previously, the remainder of the winding cycle generally follows that of a conventional surface winder in utilizing the rider roll **18**, and inclined rolldown table **21**.

As the log finishes winding, the next mandrel is inserted for transfer as the cycle repeats. The rider roll releases the finished log L''' which in turn rolls down an inclined exit table **21** to a roll strip conveyor generally designated **24**. This conveyor is similar to the roll strip conveyor on co-owned U.S. Pat. No. 3,071,259. Once the log L''' has been stripped off of the mandrel **15**, the gripper mechanism **22** lifts the mandrel **15** up onto the mandrel conveyor generally designated **35**. One or more arms are provided along the length of the mandrel in order to help support the mandrel while it is being raised to the conveyor **35**. The mandrel conveyor **35** then positions the mandrel to be received by the core inserter mechanism **14**.

Among the advantages of the invention is the ability to operate a continuous running surface winder with recycled free mandrels and without the need for using adhesive or another means for adhering the web to the mandrel. A further advantage is the novel use of vacuum to hold both the feeding web and the web leading edge portion on the bedroll **13** to accomplish an enveloping transfer. This is further advantageous, again, in the elimination of adhesive or other means for maintaining the web in contact with the mandrel.

The invention also is advantageous in that an extensible material such as rubber, plastic and the like can be used as the material for construction of the mandrel **15** so as to facilitate roll stripping. Through the use of an

extensible material, longitudinal elongation caused by the stripping forces is accompanied by a reduction in radius. The relationship of the two depends upon Poisson's ratio. In any event, the compressive grip of the convolutely wound web on the mandrel is successfully reduced and overcome by the stripping force in combination with the elongation and reduction in radius. Another advantageous function of the invention is the opportunity of using porting on the bedrolls to isolate one specific line of perforation so as to give an exact sheet count. Still further, the use of the long stationery plate is advantageous to permit a significant build up in diameter of the log before rolling in to the three roll cradle winding nip.

While in the foregoing specification a detailed description of an embodiment of the invention has been set down for the purpose of illustration, many variations in the details herein given may be made by those skilled in the art without departing from the spirit and scope of the invention.

We claim:

1. A method of coreless winding of webs into convolutely wound logs comprising the steps of continuously advancing a web for travel on a first winding drum, supporting a mandrel adjacent said first winding drum, applying a web directly to said mandrel, providing an arcuate stationary plate extending partway around said first winding drum and having an inlet and an outlet, said outlet being spaced further from said first winding drum than said inlet is spaced from said first winding drum to accommodate web buildup on said mandrel, winding said web to form a log between said first winding drum and a second winding drum, removing said log from said first and second winding drums and removing said mandrel from said log.

2. A surface winder comprising a frame providing a winding path, first winding drum means on said frame for continuously advancing a web in said path and positioned on one side thereof, means on said frame for introducing mandrels sequentially into said path for contact with said web, second winding drum means on said frame on the other side of said path for coaction with said first winding drum means in developing a convolutely wound log of said web, and means on said frame for stripping each mandrel sequentially out of its associated log, and means operably associated with said frame for enveloping each said mandrel with said web.

3. The winder of claim **2** in which means are operably associated with said frame for recycling said mandrels from said stripping means directly to said introducing means.

4. The winder of claim **2** in which said enveloping means includes an arcuate stationary plate on said frame extending partway around said first winding drum means.

5. A surface winder comprising: a frame, first, second and rider drums rotatably mounted in said frame and arranged in a three-drum cradle with a throat between said first and second drums; means for feeding a web for travel with said first drum, an arcuate stationary plate extending partway around said first drum and having an inlet and an outlet end; means for feeding a mandrel into said inlet end; said outlet end being positioned adjacent said throat and being spaced further from said first drum than said inlet end is spaced from said first drum to accommodate web buildup into a log on said mandrel; and means operably associated with said frame for axially removing said mandrel from said log buildup.

6. A surface winder comprising a frame providing a winding path, first winding drum means on said frame for continuously advancing a web in said path and positioned on one side thereof, means on said frame for introducing mandrels sequentially into said path for contact with said web, second winding drum means on said frame on the other side of said path for coaction with said first winding drum means in developing a convolutely wound log of said web, and means on said frame for stripping each mandrel sequentially out of its associated log, said frame being equipped with means for rotating said first drum about the axis thereof, said first drum being equipped with axially extending vacuum port means in surface thereof, and control means for correlating the rotation of said first drum with the means for feeding a mandrel into said inlet end when said vacuum means is adjacent said inlet end.

7. The surface winder of claim **6** in which said frame includes means for perforating said web along longitudinally spaced lines of transverse perforation, said first drum being equipped with second axially extending vacuum port means spaced circumferentially forwardly in the direction of first drum rotation of the first mentioned port means, said second port means cooperating with a mandrel at said inlet end to tension said web therebetween to snap said web along a-line of perforation.

8. The surface winder of claim **6** in which said port means includes primary and secondary port means, said primary port means being flanked circumferentially by said second secondary port means for sequentially releasing force on a leading edge portion of a severed web incident to enveloping a mandrel.

9. A method of coreless winding of webs into convolutely wound logs comprising the steps of continuously advancing a web for travel on a first winding drum, supporting a unitary mandrel adjacent said first winding drum, applying a web directly to said mandrel, providing a second winding drum adjacent said first winding drum, winding said web to form a log between said first winding drum and said second winding drum, removing said log from said first and second winding drums, removing the mandrel from said log to provide a coreless log having a small opening in the center thereof, and directly recirculating said mandrel to a position for a further supporting step.

10. The method of claim **9** in which said mandrel removing step includes providing a mandrel having an axial length sufficient to project beyond said log at least at one end of said mandrel, gripping said mandrel one end at a spaced distance from said log, inserting a stripping means in said spaced distance and moving said stripping means axially sufficient to desleeve said log from said mandrel.

11. The method of claim **10** in which said recirculating step includes gripping a mandrel from which a log is being desleeved, moving said mandrel through a path extending between a stripping position and a supporting position adjacent said first winding drum.

12. A method of coreless winding of webs into convolutely wound logs comprising the steps of continuously advancing a web for travel on a first winding drum, supporting a mandrel adjacent said first winding drum, providing means for enveloping said mandrel with said web, applying a web directly to said mandrel and enveloping said mandrel with said web, providing a second winding drum adjacent said first winding drum, winding said web to form a log between said first winding drum and said second winding drum, removing said log from said first and second winding drums, and removing the mandrel from said log to provide a coreless log having a small opening in the center thereof.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

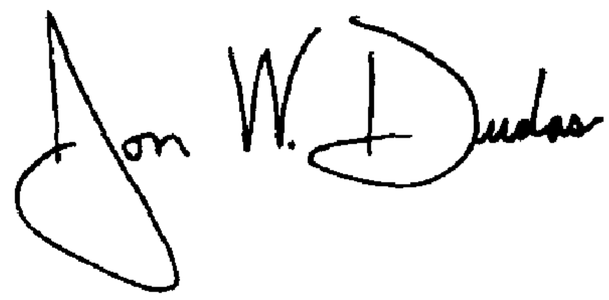
PATENT NO. : 5,421,536
DATED : June 6, 1995
INVENTOR(S) : James E. Hertel, Gerald W. Buxton and Laurence J. Oliver

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [73], Assignee, should be -- **Paper Converting Machine Company** --.

Signed and Sealed this

Fifteenth Day of November, 2005



JON W. DUDAS
Director of the United States Patent and Trademark Office